Addressing Environmental Constraints to Allow Sustainable Green Aviation

Meeting: NASA Green Aviation Workshop

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Date: April 26, 2009

Outline

- Environment and Energy Drivers
- The Challenge Ahead
- A Way Forward – The NextGen Approach
- Summary

Aviation and the Economy

- **Aviation - an engine of domestic and world economic growth**
- **Aviation growth outpaces economic growth**
- **However, economic growth must be balanced with quality of life – including environmental impact**

Download pdf at http://www.ita.doc.gov/td/aerospace/aerospacecommission/aerospacecommission.htm

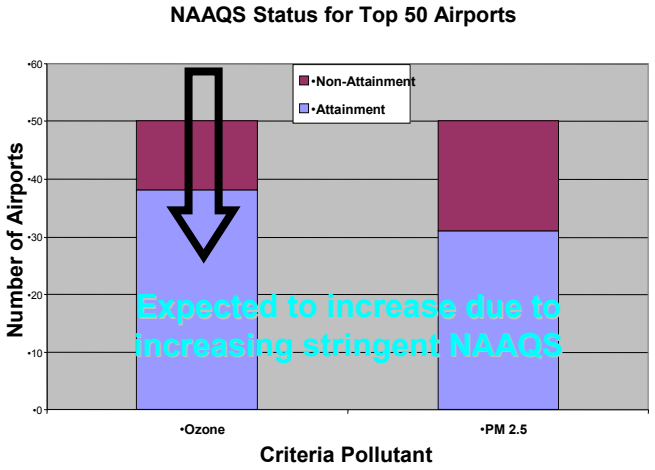
Aviation Environment and Energy

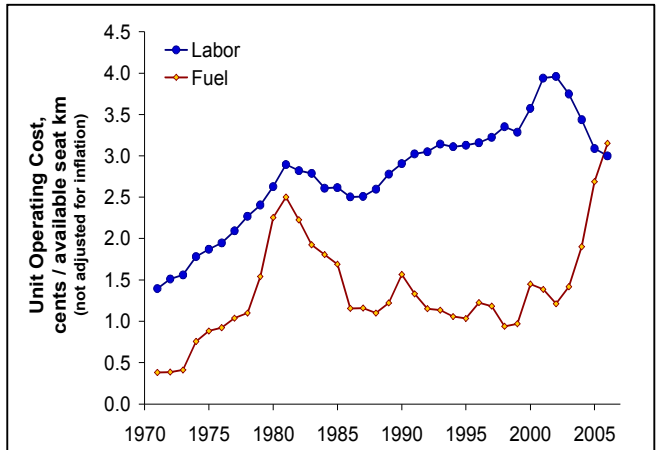
- **Aviation impacts affect community noise footprints, air quality, water quality, and the global climate**
- **Trends show environmental impacts from aircraft noise and aviation emissions will be a critical constraint on capacity growth**
- **Fundamental changes are ongoing from economic downturn, fuel costs, and financial turmoil**
- **Progressive energy efficiency is needed to favor aviation growth**

➢ ***The challenge is to ensure energy availability and affordability and reducing aviation's environmental footprint, even with projected aviation growth***

There are ongoing transient changes in aviation activities. However, long term outlook, and, hence, the need to address environment and energy issues have not changed.

Increasing Stringent Environmental Standards and Energy Concerns





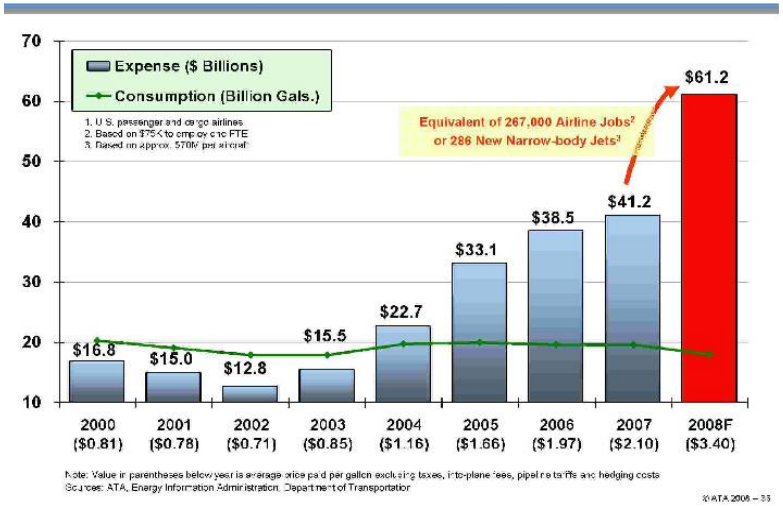
8-hr ozone standard is now 75 ppb instead of 80 ppb.

Relative contribution of aviation emissions will increase due to projected increase in its emissions and decrease in background emissions.

Increasing consideration of regulations to limit greenhouse gas emissions

2008 Jet Fuel Expense[1] Will Break 2007 Record

Total Expense (Excluding Taxes and Into-Plane Fees) Could Exceed $61 Billion



Need strategies and solutions that address long-term environmental and energy concerns

Aviation and the Environment – Important Facts

Emissions are not equal to impacts

Reduction in emissions is not linearly proportional to reduction in impacts

Emissions do not impact the environment and human health in isolation

Changing background emissions and atmospheric composition

Changing climate and atmospheric circulation

Changing population distribution, etc.

Air quality impacts are regional ('to global' ?) in nature; mostly dominated by volatile sulfate and nitrate PM, and followed by non-volatile PM

Environmental impacts of various aircraft emissions as well as cost to control them are not the same

Not one option can uniquely address all environmental issues

Underlying tradeoffs and interdependencies need to be well understood

Multiple options and approaches are often needed for balanced solutions

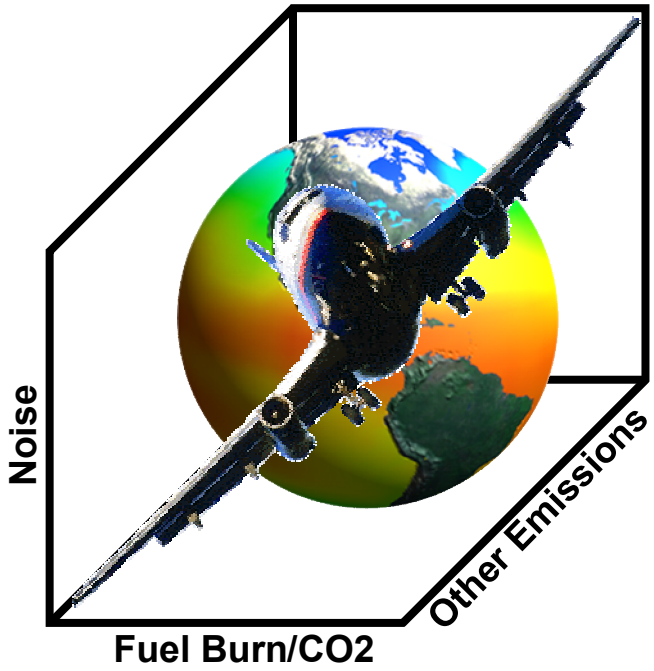
Need to better characterize the issues in order to develop informed optimally cost-beneficial targeted solutions.

Environment and Energy: Tradeoffs and Interdependencies

Nacelle Modifications
- Reduced **Noise**
- Increased **Fuel Burn/CO_2**

Increased Engine Pressure Ratio & Temperatures
- Reduced **Fuel Burn / CO_2**
- Reduced **HC** and **CO**
- Increased **NO_x**

Increased engine bypass ratio
- Reduced **Fuel Burn / CO_2**
- Reduced **Noise**
- Increased **NO_x**



Also Win-Win Solutions

Improved Aerodynamic Efficiency

Reduced Weight

Continuous Descent Arrival

RVSM

Operations changes
- Reduce **contrails**
- More **fuel burn, CO_2**

Reduced polar flights
- Less effects on stratosphere
- More **fuel burn, CO_2**

Steep climb
- Reduce **noise**
- More **fuel burn, CO_2**

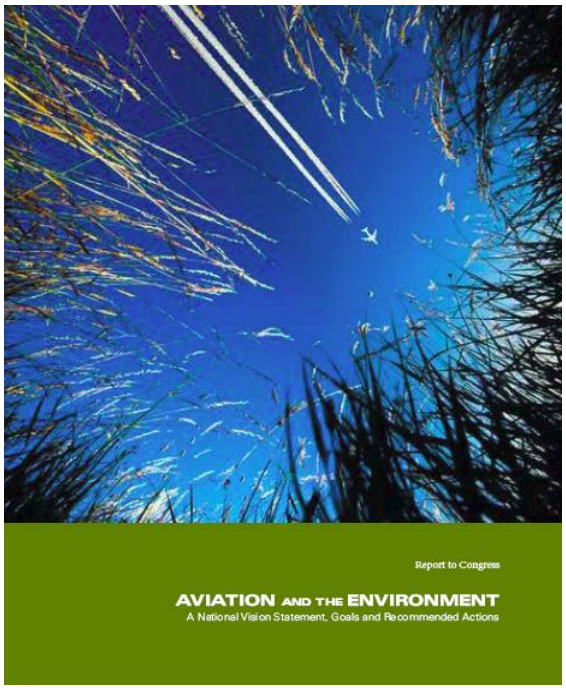
Reduce cruise altitude
- Increased fuel burn, **CO_2**
- Increased **NO_x**
- Less increase **O_3**
- Reduced **contrails**

NextGen Vision

Provide environmental protection that allows sustained aviation growth

Key Initiatives:

- Continued Local Mitigation
- Better Scientific Understanding
- Tools for Integrated Environmental Analysis
- Develop and Implement Clean, Quiet and Energy Efficient Operational Procedures
- Mature New Aircraft Technology
- Develop Alternative Fuels
- Environmental Management System for NextGen



A Way Forward: Continued Local Mitigation Efforts

- **Airport Configuration and Operation for Better Efficiency**
  - New runways, extensions, taxiways, preferential runway use
- **Airport Ground Measures**
  - Run-up areas, aircraft taxiing, noise shielding
- **Aircraft Flight Procedures**
  - Noise abatement flight tracks, departure profiles
- **Land Use Measures**
  - Land acquisition, soundproofing, easements, purchase assurance, zoning, local land use plans and controls, subdivision regulations, building codes, urban redevelopment, noise disclosure
- **Program Support Measures**
  - Noise monitoring, complaint response, pilot education, noise advisory committees, noise abatement officer, property advisory services, periodic program review
- **Voluntary Airport Low Emissions (VALE) Program**
  - Financing low emission vehicles, refueling and recharging stations, gate electrification, and other airport air quality improvements for airports in clean air non-attainment and maintenance regions.

A Way Forward: Better Understand the Problems

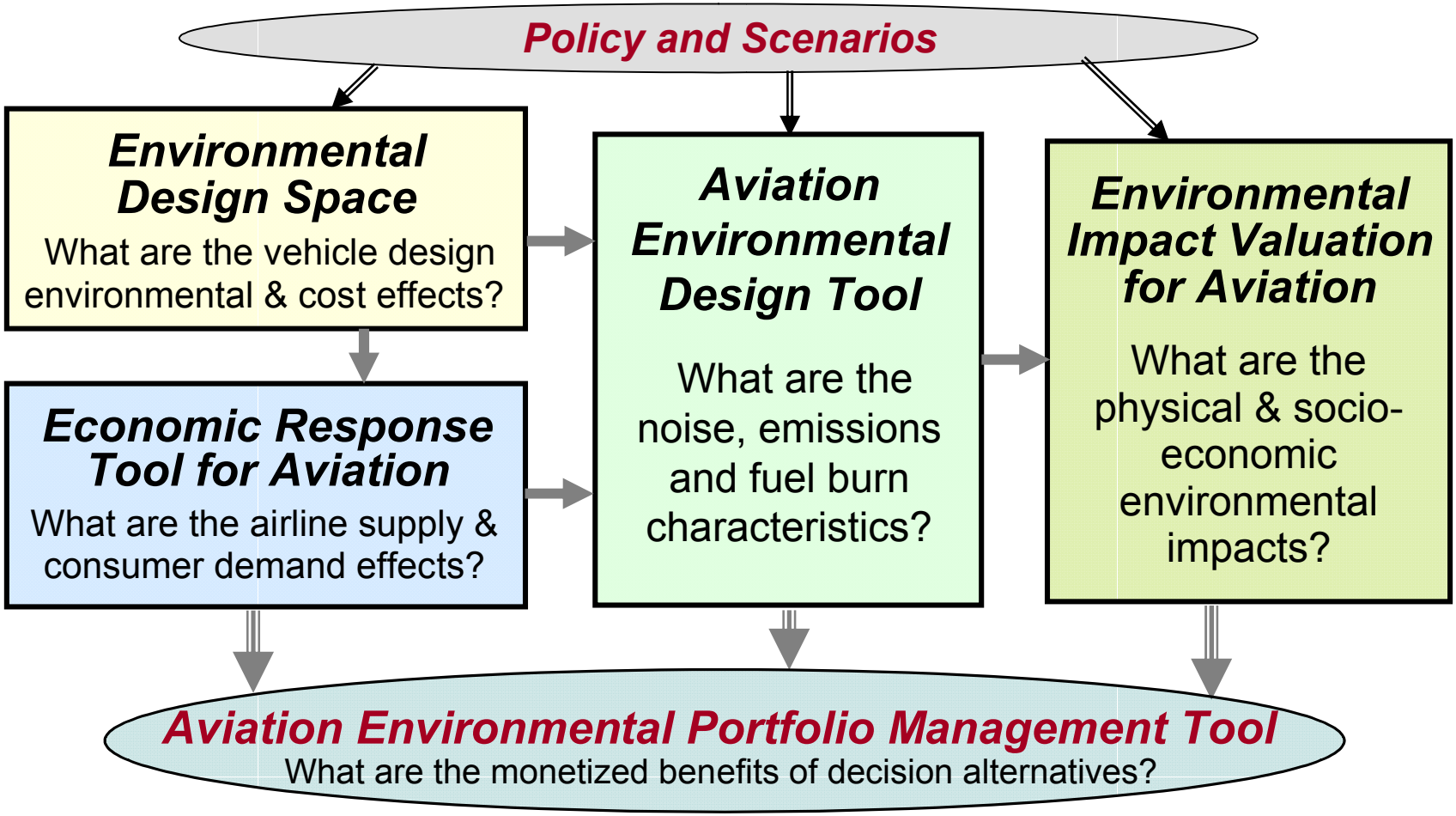
- Use better science-based understanding of the impacts of aviation emissions on climate change to make informed decisions.
- Improved metrics, measurement techniques, and modeling to quantify and predict impacts and to understand inter-relationships of aviation environmental factors.
- Research roadmaps for noise, air quality, and climate change.

Aviation Climate Change Research Initiative

ACCRI

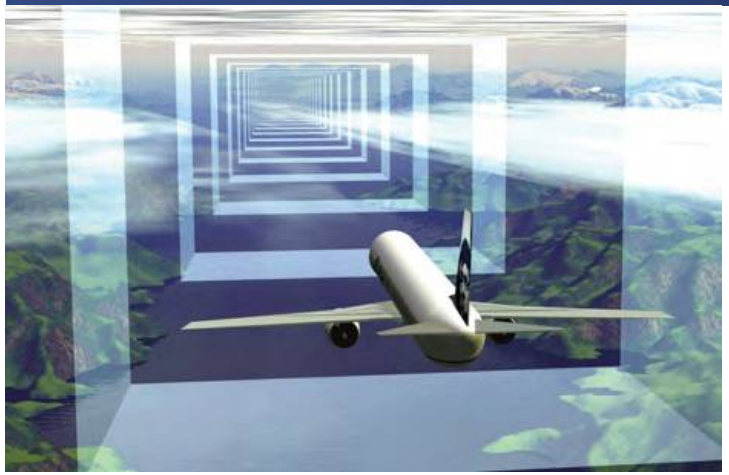
http://www.faa.gov/about/office_org/headquarters_offices/aep/aviation_climate/media/ACCRI_Report_final.pdf

A Way Forward: Tools for Integrated Environmental Analysis

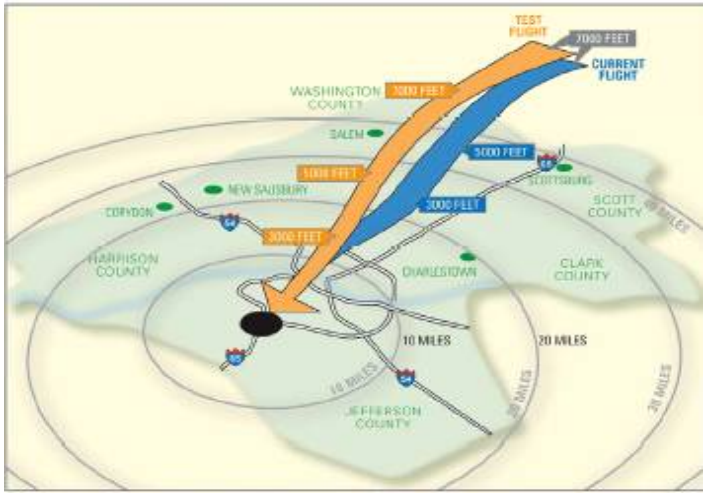


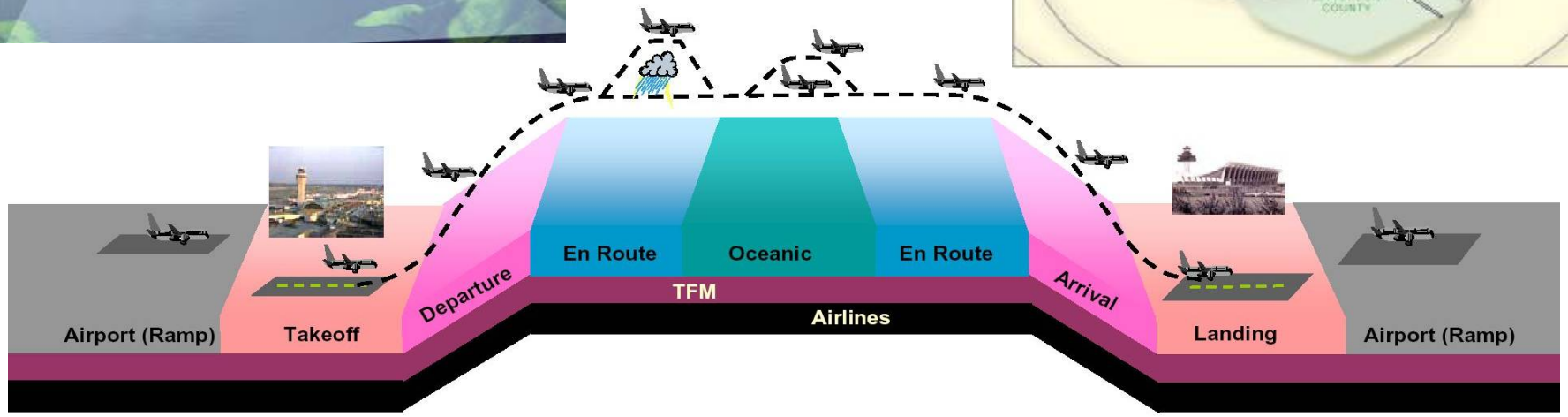
Designed to analyze tradeoffs and interdependencies of potential solution options as well as their cost-beneficial basis.

A Way Forward: Transforming Air Traffic Management



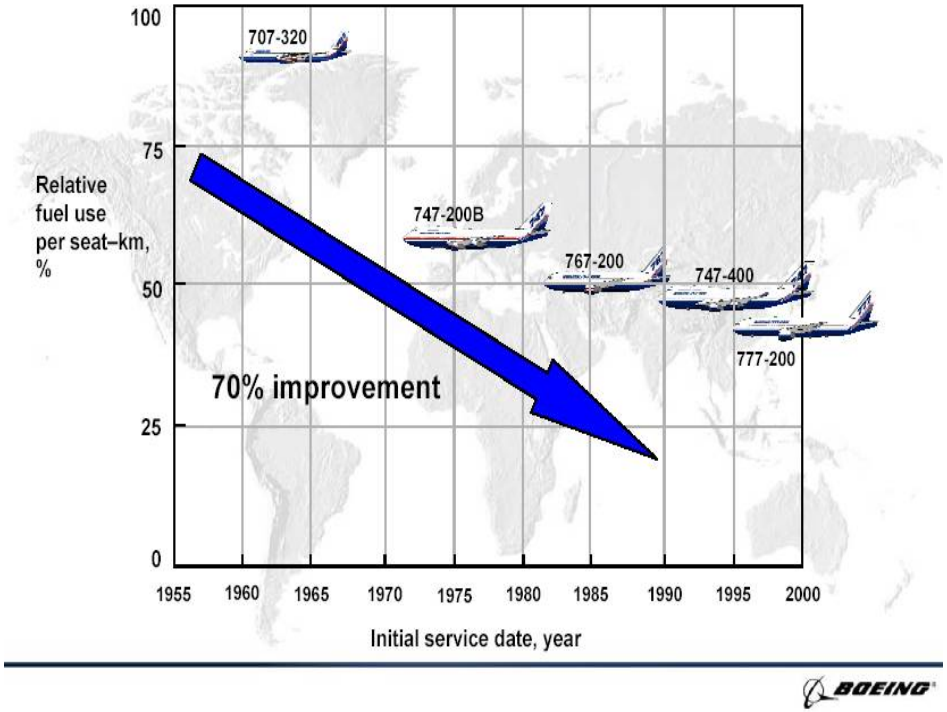
- **CDA**
- **AIRE**
- **ASPIRE**





New air traffic management capabilities, and gate to gate and surface operational procedures will allow further reduction in aviation's environmental footprint and increase energy efficiency.

A Way Forward: Fostering New Aircraft Technology



FAA Continuous Low Energy, Emissions and Noise (CLEEN) Technologies Program

Accelerate development of aircraft and engine technologies – to reduce fuel consumption, noise, air quality and greenhouse gas emissions.

Complements NSTC near-term (N+1) R&D goals

CLEEN solicitation will be posted soon.

A Way Forward: Accelerating Use of Sustainable Energy

ATA AIA CAAFI ACI FAA

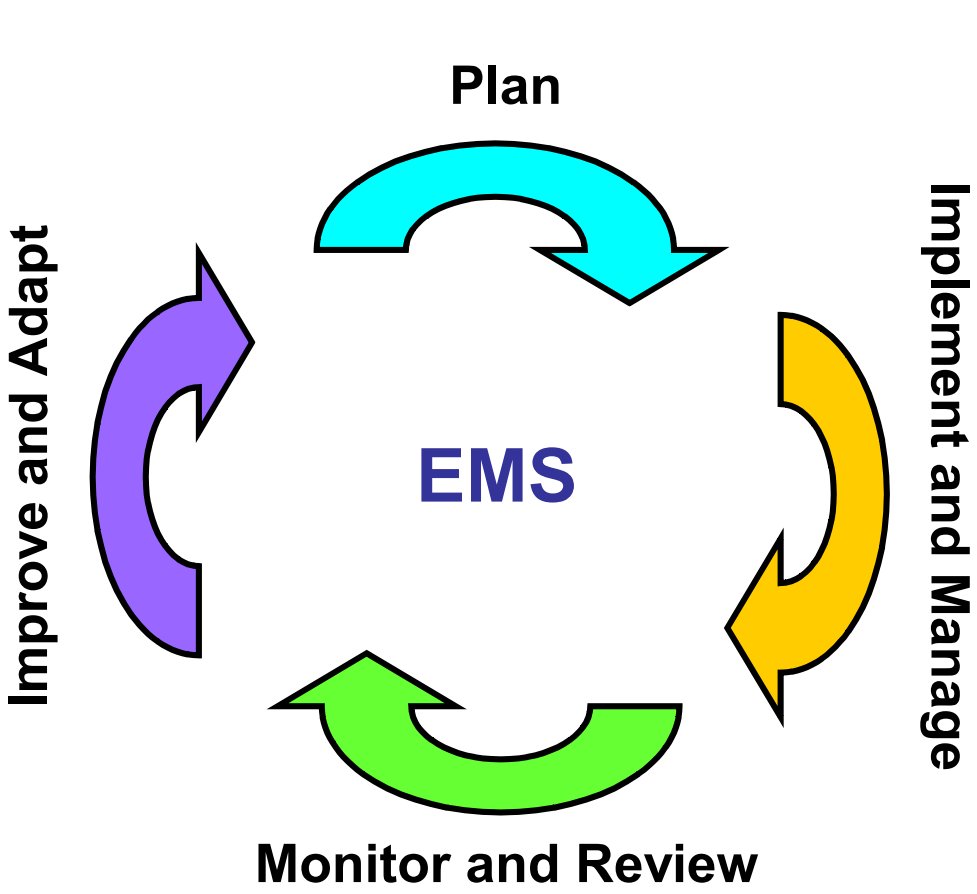
Commercial Aviation Alternative Fuel Initiative

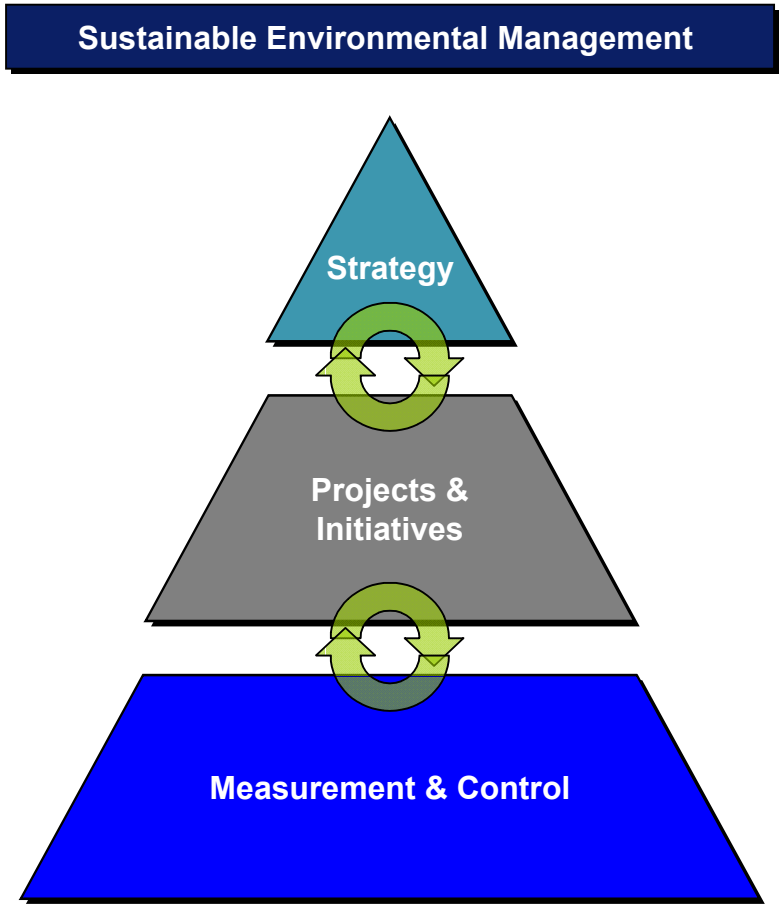
http://caafi.org

- Looking at a range of fuels
- Potential to enhance energy security and environmental performance
- Assessing business, safety, and environmental aspects
- Aggressive certification targets
- Operational use in 3-5 years

A Way Forward: NextGen Environmental Management System

*A **strategic** NextGen EMS approach will integrate environmental and energy objectives into the core business and operational strategies of NextGen to support sustained growth of green aviation*





FAA Environment and Energy RE&D Program

Characterize the problem

- Noise and Emissions Analyses
- Aircraft Noise Impacts Metrics & Characterization
- Aviation Emissions Impacts Metrics & Characterization

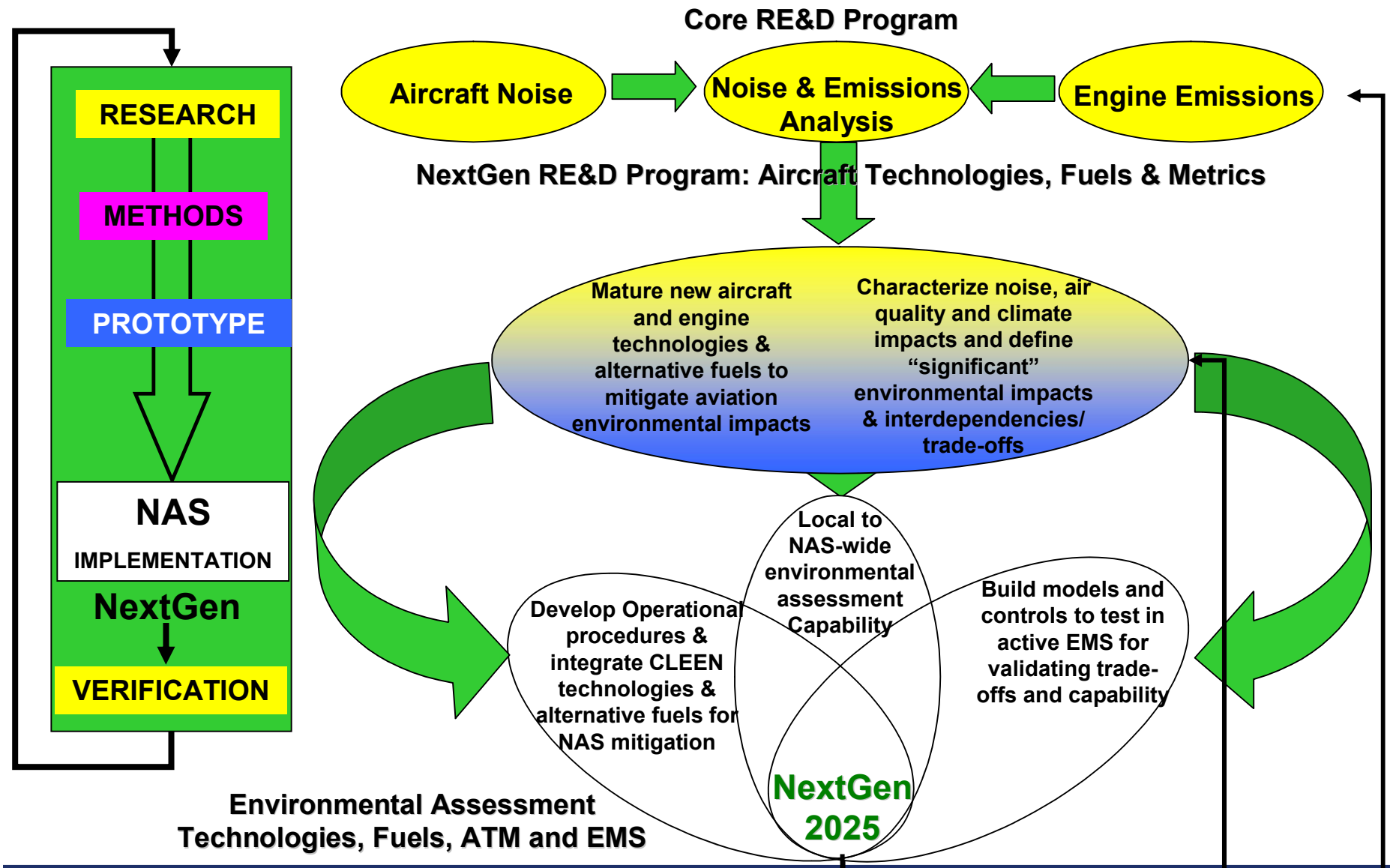
Develop Solutions

- Mature certifiable technologies and develop alternative fuels
- Explore and initiate demonstration of clean and quiet operational procedures

Manage Environmental Goals

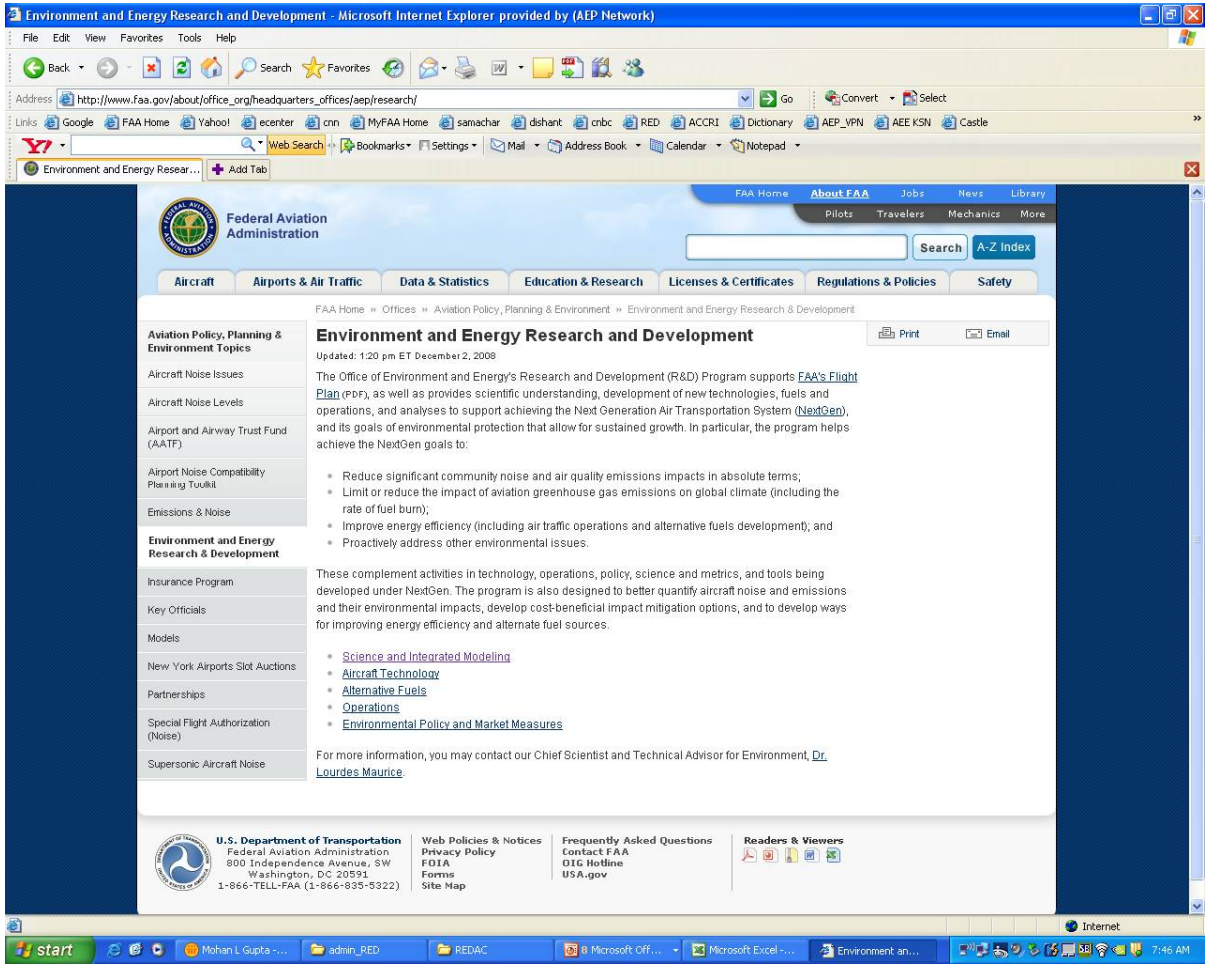
- Develop and implement Environmental Management Systems (EMS)

RE&D Program Interlinkages



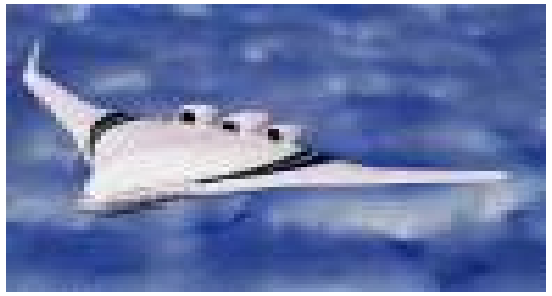
Environment and Energy RE&D Public Website

http://www.faa.gov/about/office_org/headquarters_offices/aep/research/



Summary

- **Mitigation of environmental impacts and demand for sustainable and efficient energy are the most significant challenges for growth of green aviation**
- **It's critical we understand impacts and have robust information and good metrics**
- **There is no "one best solution." Success should be based on performance- not adoption of a particular measure**
- **NextGen technology and operational improvements- with alternative fuels- could reduce or eliminate need for demand reducing market-based measures**
- **The FAA is pursuing a comprehensive integrated approach ranging from characterizing the problem, developing solutions and implementing them in a verifiable manner**



Questions?